SMERFS^3, A Tool and Methodology for Reliability Assessment

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What it is: The Statistical Modeling and Estimation of Reliability Functions for Systems^3 (SMERFS^3) is a PC based tool that allows one to determine various reliability and availability measures at either the component level (software or hardware) or the system level of any software intensive system.

Features: The tool uses observed failure data collected from the integrated, system, or operational phases of a software intensive system to fit various reliability models to that data and then use the models to estimate and predict various reliability measures. Some of the measures include: remaining number of faults for the software, mean time-to-failure, operational reliability for a specified time, testing time required to achieve a desired level of quality, and system availability.

Benefits: The tool and methodology aids in determining testing resource allocation, determining when testing should stop and when the software component should be re-engineered. For the system assessment it provides an estimate of availability. Various trade-off analyses and sensitivity studies can also be done to better judge the quality of the system.

Successes: An earlier version of the tool has been used by Lockheed Martin as a reliability check of their flight control software before each Shuttle flight. It has also been used to analyze the reliability and availability of a ground based software system and a satellite system at NASA Goddard. Within the DoD environment, it has been used to assess the quality of the Navy's TRIDENT Fire Control Software, the software of the AEGIS system, and components of the TOMAHAWK software. Earlier versions of the tool have been distributed internationally to over 300 organizations. SMERFS^3 is also included as a supplemental CD in Michael Lyu's book – *Handbook of Software Reliability Engineering*, McGraw-Hill, 1996.

Contexts in which it is best used: The tool and methodology are best applied on any software intensive system where reliability is critical factor. The methodology is best applied beginning with the integrated test phase or beyond. A mechanism should be in place that captures the faults encountered as well as associated measures of those faults. These would include failure severity, some measure of testing intensity (e.g.# testing personnel, or # test cases run), time and/or date of failure occurrence, and, if system availability is desired, time to fix the fault. Some level of statistical expertise is required in interpreting the results of the tool.

Compare with alternative known products or technologies. An alternative is Computer Aided Software Reliability Engineering (CASRE), a tool developed by JPL. This tool is based on the collection of software reliability models that SMERFS^3 contains; hence, calculated results would be the same. However, the new version of SMERFS^3 includes both hardware reliability and system availability models. No other tool packages both component and system level assessment together.

What will a successful collaboration look like?

a. **What will you as the technology provider do?** I will work with interested organizations on collaboration planning during their proposal development. I will provide a training class that will cover topics such as the nature of software reliability and system availability, the SMERFS^3 tool, and the data required for appropriate implementation. I will also work with the development tool during its implementation and assist in interpretation of the results. If a

final report is required, I will assist in its writing. I will provide whatever support is necessary to ensure the greatest chance of successful transition.

b. **What should the development team do?** Work with me in identifying an appropriate project, develop and collect the data during system development, and aid in assessing the impact that the technology had on system development. The team should also help to identify any implementation issues and offer suggestions for improving both the training and the tool.

c. **How will you, as technology provider, work together with the development team to ensure a successful collaboration?** I will work with the development team from start to finish of the development to ensure that any problems are resolved and that the team understands what the methodology and tool is accomplishing through every step of the process. I will then be available in any future applications to ensure continued success. If new updates to SMERFS^3 are developed, I will ensure that they are provided with the latest version and a description of what new features those updates provide.